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GEOLOGY AND PALEONTOLOGY.

Origin of the Trilobites.—A study of the appendages of Trilobites leads Dr. Walcott to views confirmatory of those of Bernard in regard to the origin of the Trilobites. Dr. Walcott considers the modern Crustacea as " descendants of the Phyllopod branch, and the Trilobita form a distinct branch." (Geol. Mag., May, 1894).

Bernard's lastest communication on the subject, is to the effect that the great variability in the number of segments shown by Trilobites, the formation of the head by the gradual incorporation of trunk segments, the bending round ventrally of the first segment, the " wandering " of the eyes, the existence and modification of the " dorsal organ," and especially the character of the limbs, all serve to connect the Trilobites with *Apus.* That *Apus* lies low in the direct line from the original annelidan ancestor towards the modern Crustacea, and the Trilobites probably branched off laterally from this line, anterior to the primitive *Apus*, as forms specialized for creeping, with the protection of a hard imbricated carapace. This carapace resulted from the repetition on trunk segments of the pleurae of the head segments, which together form the head shield. (Proceeds. London Geol. Soc., March, 1894).

Some New Red Horizons.—A survey of Montgomery and Bucks Counties in Pennsylvania, has shown that the New Red in the former county is 27,000 feet thick. This unexpected result harmonizes with the recorded facts in other States. A study of this region has been made by Dr. B. Smith Lyman with the view of a better understanding of the relative geological position of the different horizons from which fossils have been reported in the " so-called American New Red " of the eastern part of the United States. Mr. Lyman recognizes in the Montgomery series five distinct horizons which he names and defines as follows, beginning with the oldest:

Shales mostly soft and red, but in small part dark gray or green, or blackish with beds of brown sandstone, and of gray sandstone and pebble rock, at Norristown and eastward, about 6,100 feet; Norristown Shales.

Shales, in great part hard, dark or greenish-gray and blackish, partly dark red, at the Gwynedd and Phœnixville tunnels, with traces of coal, about 3,500 feet; Gwynedd Shales.

Shales, mostly soft and red, at Lansdale and near it, about 4,700 feet; Lansdale Shales.

Shales, in great part hard and green, partly blackish and dark red, with some small traces of coal at the Perkasie tunnel and near it, about 2,000 feet; Perkasie Shales.

Shales, mostly soft and red, at Pottstown and northeastward, about 10,700 feet; Pottstown Shales.

The author then, from fossil records, traces these horizons in other Atlantic border States. In Maryland he finds the Gwynedd and Lansdale Shales represented. In Virginia, while the total New Red thickness is not so great as in Pennsylvania, there seems to be all five divisions represented. The North Carolina fossils all appear to belong to the Gwynedd Shales. In New Jersey the divisions are traced quite across the State with the exception of a dozen miles north, south and west of Somerville where the indications are not quite certain. In this State it is noticeable that the thickness of the New Red diminishes toward the northeast, and the variation is due to the absence of the upper beds, The diminution 'extends into Connecticut in greater degree, and still more so in Massachusetts. Almost all of the fossils in these two States represent the Gwynedd Shales. A list of all the recorded New Red fossils, arranged by the author according to the different horizons, facilitates comparison.

Mr. Lyman concludes his valuable contribution to geological literature with the following remarks:

"It is not improbable that the Norristown Shales, with the great calamite near Doylestown, the apparent Lepidodendron at Newark and Belleville, and the Palaeophycus at Portland, may after all prove to be at least as old as the Permian. It seems highly probable that the well ascertained great thickness of 27,000 feet in Montgomery County should represent more than one limited paleontological period, and not only that it should include the Permian, but that the very extensive upper third of that space, hitherto almost devoid of reported fossils, should turn out to be much newer than the Triassic. Those upper beds have also shown here and there imperfect fossil traces, and as there are occasional beds of green shale among the predominant red ones, there is reason to hope that more abundant and perfect fossils may some day be found."

As for the trap, the author thinks it impossible to doubt that all the conformable trap sheets are overflows contemporaneous with the sedimentary beds, and not subsequent intrusions. (Proceeds. Amer. Philos. Soc., Vol. XXXIII, 1894).

The Gosau Beds in the Austrian Salzkammergut.—The extensive literature of the Gosau Beds is a proof of their importance from a geological point of view. Since 1832 this remarkable formation with its unique fauna has been under discussion among European geologists. In a paper published in the Quart. Journ. Geol. Soc., 1894, Mr. H. Kynaston brings together the results of previous investigation on the stratigraphy and paleontology of the Gosau Beds, and gives an account of his own observations made with reference to fixing their geological horizon. The beds are divided into an upper and lower group, the latter extremely fossiliferous, while the former is almost devoid of organic remains. On both stratigraphical and paleontological evidence, the author correlates the Lower Gosau Beds with the Turonian and Senonian of the south of France. These in turn represent the English Middle and Upper Chalks. The Upper Gosau Beds being non-fossiliferous, cannot be located definitely, but the probability is that they represent the Danian of other districts and are on the same horizon as the chalk of Maastricht and Aix-la-Chapelle.

Geology of the Rocky Mountains between the Saskatchewan and Athabasca Rivers.—During the summers of 1892 and 1893, some explorations were made in the Rockies between Howse Pass and the Athabasca Pass. This tract of mountains, including some of the grandest mountain scenery in North America, has been neglected by scientific observers, so that maps hitherto published represent it incorrectly. New lakes and rivers were discovered, heights of peaks determined, and paleontological collections made. The results of a geological reconnaisance of this region are summarized as follows by Professor A. P. Coleman:

" To sum up the geological features of the region examined, we may describe the southeastern portion, well displayed along the Brazean River, as consisting of a series of seven or more minor ranges, each striking northwest and southeast, and tilted 25°–45° toward the coast line of the Pacific. These blocks, consisting of thousands of feet of quartzite and conglomerate, often overlain by thousands of feet of Devonian limestones, appear to have been thrown into their present attitudes by a series of reversed faults, as described by McConnell in Bow Pass. The rare folds observed in this portion of the mountains represent, perhaps, the dying out of such faults. Though no Cretaceous rocks have been proved to overlie the Devonian strata, it is probable that the faulting which produced the mountains took place since Cretaceous times, for the foothills of Laramie sandstones give evidence of parallel faulting and tilting.

"On approaching the watershed of the Rockies west and northwest of the region just referred to, the regularity of the structure largely disappears. The direction and amount of dip vary, folds are not uncommon, and the rocks become more or less micaceous and metamorphosed; slates and sericite schists underlie the quartzites and conglomerates, and fossiliferous beds were not observed. The apparent absence of eruptive or plutonic rock is a feature worthy of note in a region where faulting has taken place on so huge a scale.

"The evidence of the action of Dr. G. M. Dawson's Cordilleran ice mass is distinct; the time which has elapsed since the Ice Age has been comparatively short, and the innumerable glaciers of the region represent the shrinking remnants of the ice sheet."

American Tertiary Aphidae.—It would hardly seem that plant-lice with their gauzy wings and soft bodies could be preserved in rocks. Yet they are not infrequently found. In Europe they are reported from four localities as well as from the Baltic amber. They have even been found in Mesozoic rocks. In America, Florissant, Colorado, has yielded 107 specimens, and they have been found at Green River, Wyoming, and Quesnel, B. C. The American Tertiary Aphidae have been described and figured by Dr. Scudder, and he has recently compiled a list of the species known, presenting them in a way to render their study comparatively easy and their diversity apparent. In the introduction he states that but one immature plant-louse has been found fossil in America, all the others are winged and belong to 32 species, divided into fifteen genera, of which 11 fall into the Aphidinae, the remaining four, with only five of the thirty-two species, into the Schizoneurinae, which have but a single branch to the cubital vein.

A characteristic feature of the American Tertiary Aphidae is a peculiarity in the neuration which is found also in the only wing known from the Mesozoic rocks. This feature is the great length and slenderness of the stigmatic cell. As a rule also the wings are long and narrow and the legs exceedingly short. Mr. Scudder calls attention also to the extraordinary variation in the neuration of the wings, which is strikingly greater than among living forms. (Thirteenth Ann. Rept. Director U. S. Geol. Surv. for 1891–92).

The Restoration of the Antillean Continent.—The following paper was read before the Brooklyn meeting of the Geological Society of America. It is a difficult subject of unusual interest, and it promises to be epoch making in the department of dynamical and recent geology. Two previous papers by myself have been published by the Society upon topics leading up to the present investigations, which take into consideration the characteristices of the valleys both of the southern mountains and the coastal plains, and show how the valleys are directly due to atmospheric erosion. All of the land valleys become miles in width in their lower reaches, where they are buried by recent accumulations of sand, etc., to considerable depths. Off the coast there are broad submerged plateaus or terraces marking the pauses in the changes of sea level. Across these plateaus are numerous drowned *canons* or fjords shown to reach to very great depths. From their resemblance to the land valleys, they are regarded as of atmospheric or erosion origin, After passing the limits of the sands shifted by the coastal currents and filling the valleys, it may be said that every great valley has its fjord-like continuation through the submerged margin of the continental mass, even to depths of 10,000 or 12,000 ft. or more. From the natural inference that these valleys were formed above sea level, it would appear that the land had stood as high as the fjords are deep. But this statement is modified, for the movements have been in unequal undulations, the amount of which can often be calculated, and thereby the extreme depth has been reduced so that it seems that the former elevations of the West Indian region and adjacent parts of the continent may not have stood more than from 8,000 to 12,000 feet higher than now, according to the locality. The undulations of the earth's crust have been exaggerated by mountain folds in places, but in the great majority of the drowned valleys, such has not obtained for their direction is not parallel to the mountain ridges, but across that of the continental mass. Consequently there is no escape from the conclusion that the late continental elevation is measureable, but the movement has proved to be vastly greater than had hitherto been supposed, enough to change the whole physical geography of the region, the climate and the conditions of life. During the epochs of elevation, the Mexican Gulf and the Caribbean Sea were dry plains which extended to and were drained into the Pacific Ocean. The Antillean Islands formed a plateau-bridge connecting the two Americas.

At the close of the Miocene period, the Antillean and Central American lands were represented by only small islands. Then succeeded the Pliocene period during the earlier and mid portion of which the great elevation occurred. This was succeeded by the subsidence about the close of the Pliocene period, long enough to allow the accumulation of the Matanzas limestones (of Spencer), but in amount not exceeding a depression of from 100 to 1300 feet below the present level. There was a late Miocene mammalian fauna on the continent, but it did not extend into the Pliocene period, for no mammals of that date are known east of the Mississippi River. As the fauna flourished when the continent was at about the same altitude as now, the great change in elevation, causing the subtropical climate to become subarctic, may have been sufficient reason for the restriction of the earlier life, whose descendants would have been extinguished by the drowning of the now insular region and 250,000 square miles of the continent. Again the continent rose to an altitude about as great as that of the Pliocene days, when it suffered an enormous erosion. During this earlier portion of the Pleistocene period, there was a rich mammalian fauna of horses, elephants, tapirs, camels, etc., but these were exterminated by the succeeding depression which carried down the Antillean lands to the proportions of small insular masses, and reduced the plains of the northern continent by 150,000 square miles. Since that time there have been reëlevations and minor undulations, but no connection between the islands and the continent, so that the modern types of mammals have been unable to reach the West Indies.

The changes which have occurred in the West Indies and those of the adjacent portion of the continent have been nearly identical, but the movements in the Antillies appear to have been somewhat more energetic, and the geographical evolution of the continent is best studied from the West Indian phenomena, but neither region is complete without the other. The general problem could not have been elucidated until the investigations which I have made upon the fjords.

The connection of the Antillean waters with the Atlantic and the separation from the Pacific Ocean should be noticed. There was free communication between the two oceans about the close of the Miocene period. The Pliocene union of the two continents separated the two oceans, although there may have been an enclosed sea between Cuba and Jamaica. With the subsidence of the land at the close of the Pliocene period, there was only a narrow and shallow communication between the Antillean waters and the Pacific, but the connection with the Atlantic was more complete than now. These connections were again closed during the Plistocene elevation. With the depression of mid-Plistocene days, the Atlantic was again admitted to the Mediterranean Seas, and it is also probable that there were two or three shallow passages leading to the Pacific. During the later Plistocene and modern days there have been no change of level which have effected the oceanic connection. The changes of level have been of two characters; (*a*) the epeirogenic or continent-making movements, which produce broad but gentle undulations, depressing basins or raising up barriers, but not distorting the topographic features so as to render them unrecognizable, and (*b*) orogenic or mountain-making movements, which are most energetic over limited zones, and produce disfiguring barriers. Whilst the Antillean region was sinking with gentle undulations, the Central American mass was slowly rising, but it was farther deformed by the great mountain making movements and the late volcanic accumulations, which have completed the separation of the Antillean Seas and the Pacific Ocean.

The phenomena are extremely suggestive, and from the evidence brought out it appears that many problems of physical geology will need readjustment in the light of the changed continental condition, ocean currents, climate and distribution of life. The subject is important as a contribution to the structure of land features in their interpretation of geological history.

J. W. SPENCER.

The Drainage of the Great Lakes into the Mississippi River by way of Chicago.[1]—I now add another short chapter to the history of the Great Lakes. The highest beach south of Chicago is 45 feet above the lake and there are several beaches just above the present lake level. The divide between the lake and the Mississippi drainage is only eight feet above the lake, and this at a point 25 miles southwest of Chicago. The succession of beaches at the head of the lake has led to confusion, as there is an enormous lapse of time between, for the highest amongst the oldest shore lines of the later region from its level the lake shrinks to a plain 300 feet below, whilst the waters were being drained by way of the Huron Basin and the Ottawa River. Afterwards terrestrial deformation raised the northeastern river of the basins and turned the Huron waters into the Erie and Michigan basins, and for a time overflowed the Chicago divide, which became drained about 1500 years ago by the recession of Niagara Falls through Johnson Ridge. With the terrestrial deformation continuing as in the past, it is estimated that the drainage of all the upper lakes may be turned into the Mississippi in about 5000 or 6000 years.

J. W. SPENCER.

Geological News. GENERAL.—Professor T. C. Bonney calls attention to the possibility that a rock of igneous origin can be so changed by pressure and indirect consequences as to be readily mistaken for a compact and not very much altered sediment. He instances particular cases of schistose green rocks in the Alps which upon examination prove to be the result of crushing without shearing. The author suggests that modified igneous rocks may form a large part of the *Grüne Shiefer* of the Swiss geologists. (Quart. Journn. Geol. Soc., May, 1894).

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[1] Abstract of paper read before the American Assoc. Adv. Science.

ARCHEAN.—Evidence is presented by Mr. J. E. Spurr for correlating the Thompson slates, which occupy an extensive area in eastern Minnesota, with the Keewatin of the Mesabi Range rather than with the Animikie of that district. If the suggested correlation is correct, it will follow that the erosion interval between the Animikie and the Keweenawan was very great. (Am. Journ. Sci., Aug., 1894).

CENOZOIC.—M. L. Cayeux calls attention to the presence in the precambrian formations of Bretagne of Foraminifera of a relatively complex form associated with a large number of Radiolaria. The rocks which contain these organisms are quartzites and phtanites interstratified with the precambrians of Saint Lo. (Revue Scientif., 1894).

The discovery of certain fossil corals in Shasta and Siskiyou Counties in California, demonstrates the undoubted presence of middle Devonian deposits in that region. Notes on these fossils are given by Mr. Schuchert in Am. Journ. Sci., June, 1894, together with some correlations of the beds in which they were found with those of other regions. The Shasta County fossils are believed to indicate the Corniferous terrane as developed in New York, Kentucky, Michigan and Ontario. Those of Siskiyou County are of younger age, and agree in a few cases specifically with those of the Devonian of the White Pine Mining District in Nevada.

Mr. A. Smith Woodward records four new fossil fishes from the Karoo Formation. The descriptions are accompanied by plates showing the specimens natural size. Three of the fossils are Palaeoniscidae and the fourth belongs either to that family or to the Platysomidae. (Ann. Mag. Nat. Hist., 1893).

Newberry's genus, Spiraxis, is represented in the Devonian of Belgium. M. Stainer in describing this curious spiral fossil agrees with Newberry in supposing it to be the remains of a species of alga, and gives it the name *Spiraxis interstrialis.* (Bull. Soc. Belge de Geol. Pal.

et Hydrol., 1894). Dr. Hollick, however, shows that the bodies thus described are the casts of the spiral intestine of Cladodont sharks. (New York Acad. Sciences.)

MESOZOIC.—According to M. Lechien, the invertebrate fossils found in the bed from which the famous Ichthyosaur of Arlon was taken, indicate a formation belonging to the middle Lias instead of lower, as was at first supposed. (Bull. Soc. Geol. Bruxelles, 1894).

CENOZOIC.—The old theory first advanced by Shaler in 1870, of the origin of drumlins by a destructive process, that is, a working over of morainic or other drift deposits, have been revived by Prof. R. S. Tarr. He brings forward facts to support it, and discusses three objections to it, but concludes on the whole that this theory forms a good working hypothesis, even if it is not accepted as the most probable theory. (Am. Geol., June, 1894).

Mr. Warren Upham offers, as an explanation of the Plistocene climatic changes, the epeirogenic theory of the Ice age thought out and formulated by Dana, Le Conte, Wright, Upham and Jamieson. He conceives the Ice age to have been essentially one and continuous, with important fluctuations. Soundings off the West African Coast record a submerged channel of the Congo extending eighty miles into the ocean to a depth of more than 6,000 feet. Another deep submarine valley having soundings of 2,700 feet is known on the African Coast 350 miles north of the equator, and there is a similar valley in the southern part of the Bay of Biscay. These remarkable valleys beneath the sea level indicate that probably the entire Atlantic side of the Eastern Continent has been greatly uplifted within late geologic time. (Geol. Mag., Aug., 1894).

In regard to the "Black Earth" of Russia, Dr. W. F. Hume suggests (1) the position of Loess has been determined by the manner and conditions of its origin, and (2) Black Earth is merely a special closing feature in the sequence of a long history of Loess, and it is merely that deposit rich in humus resulting from the decomposition through long ages, of generations of grasses and steppe plants. (Geol. Mag., Aug., 1894).

The Yellow Gravel of New Jersey is made the subject of special discussion in the report of Prof. Salisbury upon the surface geology of that State. After giving its distribution and its history as inferred from its character and position, the author states that the study of this formation leads to the following conclusions:

(1) The original yellow gravel is Pre-plistocene. (2) The time of its deposition was followed by an epoch of elevation and extensive erosion of long duration. (3) Then came a period of depression during which the Columbia deposits were made, equivalent in age with the first glacial deposits. (4) Again an epoch of elevation and erosion, when the degradation and redistribution of the original formation went forward. (5) An epoch of slight depression. (6) Subsequent elevation to the extent of forty to sixty feet, followed by the present subsidence. (Ann. Rept. Geol. Surv. New Jersey for 1892).